

**Scott Marrett and
Diane Fisher**

ARTICLE

Picture the Beauty of Technology

Editor's Note: Dividing information into disciplines often gives us a distorted and less than satisfying understanding of the world. We may have an understanding of one of the "laws of nature" or be able to recite how a technology works. But we may not have actually integrated this knowledge with our experience. This space-related activity integrates science and technology with art. It gives students, parents, and teachers the opportunity to use a technological concept as a theme for a work of art.

This contest is sponsored by the Jet Propulsion Laboratory (JPL), California Institute of Technology, under contract to the National Aeronautics and Space Administration. It describes some of the advanced technologies to be flown and tested in space for the first time on the Earth Observing-1 mission, managed by NASA's Goddard Space Flight Center in Greenbelt, Maryland. You can learn about this mission at <http://eo1.gsfc.nasa.gov>. This and other missions are also featured on The Space Place, JPL's fun Web site for children at <http://spaceplace.jpl.nasa.gov>.

Put Yourself in Orbit

Imagine you are a spacecraft orbiting Earth, more than 700 kilometers (420 miles) up. You look down and see the beautiful blues and browns and greens of the surface. What's more, you carry several instruments that let you see the world as humans have never seen it before.

You can see all the usual

colors, but it is much easier to see tiny differences among colors—for example, among different shades of green. You can also see light in long (infrared) wavelengths that are invisible to humans. Why, you can even look at a forest and tell the lodgepole pines from the cedars, the grand firs from the sitka spruce!

You also carry an instrument that lets you see through Earth's atmosphere as if it weren't even there.



Figure 1 - EO-1 Satellite

The energy to power your instruments comes from your super-lightweight solar arrays that convert the sun's rays to electricity. And for making small corrections to your orbit, you have a high-tech, pulsed plasma thruster with only two moving parts. By releasing very tiny pulses of gas, the thruster lets you maintain a very exact orbit—very important, since you are formation flying with the Landsat 7 satellite.

The spacecraft you are imagining yourself to be is called Earth Observing-1, or EO-1. EO-1 will be launched in January 2000.

Scott Marrett is a consultant with Market Evolution in Westlake Village, California, and Diane Fisher is a science and technology writer at Jet Propulsion Laboratory, Pasadena, CA and the designer of The Space Place. Thanks also to Nancy Leon, educational outreach liaison for NASA's New Millennium Program, of which Earth Observing 1 is part.

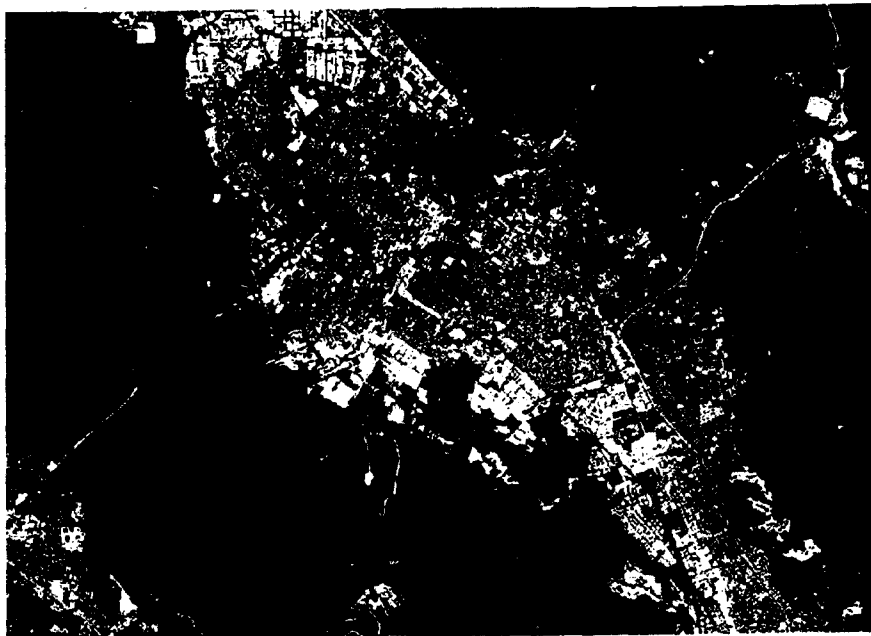


Figure 2 - This image of the Freemont, California area was made from Landsat 7 data. You can see the San Francisco Bay in the lower and left-hand side of the image. The patchwork of odd shapes south and west of the city is the San Francisco Bay National Wildlife Refuge, which include a salt marsh, tidal sloughs, mudflats, and salt ponds.

What a view! What a ride! You see things from up there that no one can see from Earth, or even from a jet airplane. You are recording images of almost the entire Earth's surface and sending them back to mission control at Goddard Space Flight Center in Greenbelt, Maryland. The images will be analyzed and compared with the images the Landsat 7 is taking to see how well your new technologies work. For this is the first time they have ever flown in space.

Let the World See Through Your Eyes

If you find it inspiring to think about space and space exploration, and to imagine seeing our whole

beautiful planet at once in exquisite detail, why not use that inspiration to create a work of art?

The New Millennium Inspirations Program challenges you to do just that! Create an original work of art that shows the spirit of exploration and also expresses something about one or more of EO-1's new technologies (which we'll tell you more about in a minute). It can be a drawing, painting, sculpture, collage, or anything you want, as long as you can show it to us on no larger than an 8-1/2 x 11 inch piece of paper. For example, if you do a big collage or a 3-D sculpture, you can send us a photograph of it.

- Start by reading and learning about EO-1's technologies in

the explanations that follow. We also give you hints about ways to artistically interpret some part of each technology. How does Earth look using this technology? How does space or life on Earth look? Is the technology used to sense color, light, shape, or image? You may take off from one of our hints, or better yet, create a personal artwork of your own interpretation.

- Use imagination and stretch the boundaries of your creativity—just like NASA's scientists have used their imaginations in developing these new technologies. Art is a very personal form of expression, but you may also form a team to work together on the art.
- When you complete your project, use the form at the end of this article to submit your artwork to the New Millennium Inspirations Program coordinator. From these entries, a panel of art and science professionals will select nine works, three in each age category. The winning entries will be displayed prominently on the campus of the Jet Propulsion Laboratory in Pasadena, California.

See the World through a Space-age Technology

Here are some short descriptions of eight of the advanced technologies to be tested in space on EO-1, along with hints about how they might be represented in a work of art.

Hyperspectral/Multispectral Imaging Spectrometer:

Explanation: A spectrometer is an instrument that breaks light into its different colors (frequencies) and then precisely measures those frequencies. The Hyperspectral/Multispectral Imaging Spectrometer will photograph Earth from space. Previous missions have used spectrometers to image various landscapes on Earth, such as deserts, mountains, and oceans. EO-1's advanced spectrometer can not only detect landscapes, but can also see tiny differences between similar landscapes. For example, EO-1 will return images of forests that distinguish between different kinds of trees.

Artistic Hint: You could photograph small differences between natural things on Earth. For example, you could photograph a forest or small grove of trees during different seasons. Or you could photograph interesting rocks with subtle differences of color or texture.

X-Band Phased Array Low-cost Antenna:

Explanation: The Phased Array Antenna is unlike the usual dish-type antennas that have been used on spacecraft to send data and images back to Earth. This antenna is flat, with an array of 64 cylinder-shaped amplifiers that direct the signal to Earth electronically. The antenna has no moving parts and is very lightweight. It can send a large amount of data in a very short time.

Artistic Hint: Consider that

this technology combines a number of smaller elements (64) in a pattern to make up the whole effect. Or, consider that its purpose is communication.

Atmospheric Corrector:

Explanation: Depending on how much water vapor and other aerosols (tiny particles of liquid) are in the air, Earth's atmosphere scatters light and distorts images received by spacecraft taking photographs from Earth orbit. The Atmospheric Corrector continuously measures the amount of distortion from water vapor and corrects the resulting image to eliminate the distortion. It uses an advanced, electronic, wedge-shaped filter.

Artistic Hint: Distortion and clarity are themes of this technology. Images distorted by water and/or water vapor might illustrate this idea.

Enhanced Formation Flying:

Explanation: The EO-1 spacecraft will use advanced computer software to calculate exactly where it is and where it should be at all times, and to plan and carry out any needed corrections in its orbit. Thus, EO-1 will be able to maintain its position following the exact orbit of Landsat 7, but one minute behind.

Artistic Hint: This technology enables separate objects to move in precise formations, without human operators. You could connect a series of points to create a pattern, and copy the pattern to indicate movement in formation.

Carbon-Carbon Radiator:

Explanation: The EO-1 Carbon-Carbon Radiator will be used to help cool the electronics inside the spacecraft. Radiators have previously been made of aluminum. This new carbon-carbon radiator material, made in a honeycomb pattern, is stronger and lighter weight than aluminum, and dissipates heat even better than aluminum.

Artistic Hint: Consider that this material is made in a repeating honeycomb pattern for use as a radiator. Even though apparently light and mostly hollow, it is still very strong.

Lightweight Flexible Solar Array:

Explanation: A spacecraft's solar array converts the sun's energy to electrical power for the spacecraft. The Lightweight Flexible Solar Array uses a new energy-capturing material for the solar cells that makes them lighter and provides more power than previous materials. Also, the hinges of the solar array are made of shape-memory alloys so the panels can be gently unfolded without the use of exploding bolts.

Artistic Hint: The sun's light and energy have inspired artists since the beginning of our species.

Pulsed Plasma Thruster:

Explanation: The EO-1 spacecraft must be able to make very small, precise corrections in its orbital speed and direction. The Pulsed Plasma Thruster uses electricity to convert solid Teflon propellant material into a plasma (an electrically charged gas), which

is released in tiny pulses to change the speed or direction of the spacecraft. The thruster is small, self-contained, and has only two moving parts.

Artistic Hint: Consider a theme of "making tiny adjustments." Or consider a moving work of art with two objects interacting with one another.

Wideband Advanced Recorder/Processor (WARP)

Explanation: The WARP records all the data being gathered by the imaging instruments. It can receive data arriving at a very high rate and store a huge amount of data on each of its memory cards. Its data processor can also compress and process land image scenes.

Artistic Hint: This technology concerns the capture and processing of information. Consider other examples of storing objects or information or transferring them from one place to another.

Contest Rules

- Anyone is eligible to submit one entry (individual or teamwork project). Non-U.S. Citizens are also eligible to enter the program.
- Submissions must be identified in one of the following categories based on the artist's age:
 - ✓ Child, Ages 6-12
 - ✓ Young Adult, Ages 13-18
 - ✓ Adult, Ages 19 and older
- Submissions must be provided on a two-dimensional medium, such as paper, art boards, or canvas, no larger than 8.5" x

11". Submissions may be original art, photographs, or other duplicate representations of the artwork.

- Each submission must represent one or more EO-1 technologies, identified on the entry form. Also, the artist's name, address, and phone number must be included on the entry form for possible future contact.
- All New Millennium Inspirations Program submissions must be received no later than April 30, 2000.
- Submissions become property of NASA and will not be returned to entrants.

Awards

- Three entries from each age group will be selected for display on JPL's campus. Each

winning artist will also receive an EO-1 mission poster signed by each scientist and engineer on the mission.

- Winners will be announced during the summer of 2000 and will be notified by regular mail. Their names and images of their artwork will also be featured on JPL's web site for kids, The Space Place (<http://spaceplace.jpl.nasa.gov>). Artists' names and submissions may be featured in news releases and other media materials.

Criteria for Selection

- Originality
- Best reflection of the spirit of exploration
- Demonstration of an understanding of one or more EO-1 technologies

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**New Millennium Inspirations Program
Art Contest Entry Form**

Deadline: April 30, 2000

Name: _____

Address: _____

Phone: _____

Age category of artist (check one):

- ☐ Child (6-12 years)
- ☐ Young adult (13-18 years)
- ☐ Adult (19 years and over)

EO-1 technologies represented in artwork
(check one or more):

- ☐ Hyperspectral/Multispectral
Imaging Spectrometer
- ☐ X-Band Phased Array Low-cost
Antenna
- ☐ Atmospheric Corrector
- ☐ Enhanced Formation Flying
- ☐ Carbon-Carbon Radiator
- ☐ Lightweight Flexible Solar Array
- ☐ Pulsed Plasma Thruster
- ☐ Wideband Advanced Recorder/
Processor (WARP)

Send entry to:

New Millennium Inspirations Program
International Technology Education
Association
1914 Association Dr., Suite 201
Reston, VA 20191-1539

JUST ADDED!

**The following sessions pertaining to the
Technology Content Standards**

Salt Lake City, Utah

April 6-8, 2000

Thursday 1:30- 4:00pm

Implementation of the Content Standards

Thursday 10:30-11:15pm:

**Content Standards: Their Implications for
Elementary School TE Programs**

**Friday 10:30-11:30pm: Using the Content Standards
as PR For Your Program**

**Friday 1:00-2:00pm: How to Implement the
Standards In Your School or State System**

**Friday 3:00-4:00pm: How to Inservice/Preservice
Teachers For The Standards**

**Friday 5:30-6:30pm: Do Your Products Really
Reflect the Standards?**

Complete information will be available soon.

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